

PATENT COOPERATION TREATY

From the
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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43bis.1)

Date of mailing

(month/year) see form PCT/ISA/210 (second sheet)

2003P07553W0

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/EP2004/025513

International filing date (day/month/year)
21.05.2004

Priority date (day/month/year)
23.05.2003

International Patent Classification (IPC) or both national classification and IPC
G01R33/3873

Applicant
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1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

10/557829
IAP12 Rec'd PCT/PTO 22 NOV 2005
International application No.
PCT/EP2004/005513

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
☐ a sequence listing
☐ table(s) related to the sequence listing
 - b. format of material:
☐ in written format
☐ in computer readable form
 - c. time of filing/furnishing:
☐ contained in the international application as filed.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/EP2004/005513

Box No. II Priority

1. ☒ The following document has not been furnished:

- ☒ copy of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(a)).
- ☐ translation of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(b)).

Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rule 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-12
	No: Claims	
Inventive step (IS)	Yes: Claims	3-6, 8 (after clarification)
	No: Claims	1, 2, 7, 9-12
Industrial applicability (IA)	Yes: Claims	1-12
	No: Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

- 1 The following documents are referred to in this written opinion, the numbering will be adhered to in the rest of the procedure:**

§1 D1 = EP-A 1 154 280 ✓
§8 D2 = US 2002/0056185 ✓
§2 D3 = US-A 2002/0021129 ✓
§4 D4 = US 4,672,346 ✓
§3 D5 = EP-A 0 921 408 ✓

- 2 Re Item V: Reasoned statement under Rule 43bis.1(a)(i) PCT**

2.1 Lack of an inventive step (Art. 33(3) PCT)

Independent claims 1, 9, 10, 12

Claims 1, 10

The subject-matter of claim 1 would appear to lack an inventive step with respect to a combination of documents D1 and D3 for the following reasons.

Document D1 discloses (references in parentheses referring to D1):

A static magnetic field generating apparatus in a MR equipment (see par. [0008]) comprising:

- magnetic sources (the superconducting magnet 30 in figure 1, see par. [0016]), C-type framework as the magnetic path (see figure 1), the measured body is positioned in the space between the two opposite end faces of the magnetic sources (see the patient support surface 22 in figure 1), wherein the said two opposite end faces are mirror symmetrical by the virtual plane between the two faces (see figure 1),
- a gradient coil (the gradient coil 52 in figure 1, see also par. [0020]),
- a first shimming ring is employed outside the gradient coil, surrounding the

gradient coil (the outer portion 40 of the Rose ring in figure 1, see par. [0017]), wherein the gradient coils, RF emitting coils and the first shimming rings are mirror symmetrical with respect to the virtual plane between the two opposite end faces (see figure 1),

- an additional second shimming ring on the external edge of the first shimming ring (the inner portion 42 of the Rose ring depicted in figure 1, see also par. [0017]), wherein the distance with respect to the first shimming ring is adjustable (par. [0017] states that the gap 44 between portions 40 and 42 of the Rose ring is an "air gap of 10-15 mm"; therefore, it is considered that, at least during the initial setup of the magnet device disclosed in D1, the gap 44 is "adjustable"),
- the two second shimming rings are essentially symmetrical by the above virtual plane (see the symmetry of the upper and lower magnet poles depicted figure 1)

The subject-matter of claim 1 differs from that of D1 only in that the apparatus comprises permanent magnetic sources, pole plates which are placed on each of the opposite end faces and pole pieces which are employed beneath each of the two aforementioned pole plates rather than a superconducting magnet source as in D1. This difference involves that the pole plates and the pole pieces are mirror symmetrical with respect to the virtual plane between the two opposite end faces.

The corresponding technical effect of employing permanent magnetic sources rather than superconducting magnet sources is a simplified magnet assembly since the cryogenic vessel which is indispensable when using superconductors can be omitted.

Therefore, the problem to be solved consisted in providing an alternative arrangement wherein the cryogenic vessel is dispensable.

Given this problem, the skilled person would consider the possibility of employing permanent magnetic sources since this possibility and its advantages are well-known in the art.

More specifically, the skilled person would consider document D3. The problem is solved in D3 by employing permanent magnetic sources (the magnets 72 and 72' in figure 3A, see also par. [0037]), wherein pole plates are placed on each of the opposite end faces (the pole piece bases 51 and 51' in figure 3A, see also par. [0037]) and pole pieces are employed beneath each of the two aforementioned pole plates (the pole pieces 74 and 74' in figure 1, see also par. [0037]).

Therefore, the skilled person would arrive at the subject-matter of claim 1 without the exercise of any inventive skill.

At least implicitly, document D1 discloses a method of adjusting the static magnetic field in a MR equipment as well. Therefore, the lack of an inventive step holds also for claim 10.

Alternatively, the subject-matter of claim 1 would appear to lack an inventive step also when starting from a document disclosing a permanent magnetic structure with a first shimming ring (e.g. document D2) and combining the teachings of document D1.

Claims 9, 12

The subject-matter of claim 9 would appear to lack an inventive step with respect to a combination of documents D5 and D4 for the following reasons. It is noted that the clarification given in item 5.10 d) below is used to compare the subject-matter of claim 9 with the prior art.

Document D5 discloses a magnet according to the preamble of claim 9 (see the magnet depicted in figure 15, it is noted that the magnetized ring 113 can be considered to represent the first shimming ring; moreover, although D5 does not mention gradient coils or RF coils at all, their presence is mandatory since D5 mentions the use of the apparatus disclosed therein in the context of "NMR image detection" (see e.g. the abstract). Therefore, it would appear that the skilled person would employ biplanar gradient and RF coils which are well-known in the art (documents will be cited, if necessary)).

Moreover, D5 discloses that the magnetic source comprises plural groups of permanent magnetic columns of different magnetic energy levels, and said columns are symmetric in respect to magnetic energy level to axes on the pole plate plane through the central point of the pole plate plane (see figures 15, 16 and par. [0063]; members 102 and 214 are made of magnetized material; therefore, the inner circular region defined by the pole piece 202 can be considered to form a first column with a particular magnetic energy level defined by the corresponding portion of the magnetic member 102, whereas the annular region defined by the annular member 14 represents a second column that possesses a different magnetic energy level since, in this annular region, the additional magnetic member 214 is present).

The subject-matter of claim 9 differs from that of D5 only in that magnetic **conducting** bolts or permanent magnetic bolts are provided symmetrically along the end face axis of the permanent magnetic source. However, it would appear that the skilled person, desiring to provide means for regulating the magnetic field in the air gap, would consider document D4 (see the embodiment depicted in figure 11 wherein the magnetic material 19 and the adjusting bolt 21 can be considered to represent a "magnetic conducting bolt"; see also col. 8, lines 33-46).

Likewise, the subject-matter of claim 12 would appear to lack an inventive step with respect to a combination of documents D5 and D4 as well.

Dependent claims 2, 7, 11

Claim 2

The additional feature of claim 2 is known from D1 as well (see the RF coil 50 and the second shimming ring 42 depicted in figure 1).

Claims 7, 11

It is noted that the clarification given in item 5.10 d) below is used to compare the subject-matter of claim 11 with the prior art.

The subject-matter of claims 7 and 11 would appear to be obvious with respect to

document D4 (see the embodiment depicted in figure 11 and col. 8, lines 33-46).

2.2 Novelty and inventive step of claims 3-6, 8

Document D2 which discloses a permanent magnet device with a first shimming ring is considered to represent the closest prior art.

The subject-matter of independent claim 1, upon claim 3 is being dependent, differs from that of D2 (see e.g. figure 1) in that a second shimming ring is provided on the external edge of the first shimming ring, wherein the distance with respect to the first shimming ring is adjustable.

Moreover, the subject-matter of **claim 3** differs from that of claim 1 in that the permanent magnetic sources comprise plural groups of permanent magnetic columns of different magnetic energy levels.

Both the additional, second shimming ring and the permanent magnetic columns of different magnetic energy levels solve the same technical problem, namely increasing the field homogeneity of the magnet device.

Although the provision of a second shimming ring (see e.g. D1) and the provision of permanent magnetic columns of different magnetic energy levels (see e.g. D5) is well-known in the art, no single additional document discloses the combination of features defined in claim 3.

Therefore, the skilled person would have to combine the teachings of three documents to arrive at the subject-matter of claim 3 and any such attempt would appear to be driven by hindsight since the various documents relate effectively to the same technical problem. Accordingly, the applicant is given the benefit of any remaining doubt.

Thus, **disregarding the objections under Art. 6 PCT given below**, the subject-matter of claim 3 would appear to be novel and inventive. Likewise, the same is true for claims 4-6 and 8 being dependent on claim 3.

3 Re Item VII: Certain defects in the international application

- 3.1 According to Rule 5.1 a (ii), documents D1-D5 should be identified in the description and briefly discussed.
- 3.2 Claim 1 should have been drafted in the two-part form in accordance with Rule 6.3(b) PCT, with those features known from the prior art (probably document D2) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).
- 4 The applicant is informed that a lack of unity might arise once the objections under Art. 33 PCT have been overcome.

5 Re Item VIII: Lack of clarity and support in the description

- 5.1 The various definitions of the invention in two independent apparatus claims and two independent method claims are such that the set of claims as a whole is not concise. The claims should have been drafted to include only one independent claim per category with dependent claims that cover features that are merely optional.
- 5.2 The present set of claims contains a multitude of unclear expressions wherein a plural form of a term is combined with an article in its singular form or vice versa (e.g. "a gradient coils" in line 13 of claim 1; "a plural groups" in line 3 of claim 3). Therefore, it remains unclear, whether e.g. claim 1 covers an apparatus that contains only one single gradient coil.
- 5.3 A consistent terminology should have been used throughout the set of claims (e.g. in line 14-15 of claim 1 the RF coil is termed "RF **transmitting** coil" whereas the term "RF **emitting** coils" is used in line 19 in claim 1; the "first shimming ring" defined in line 16 of claim 1 is termed "shimming ring" in line 26 of claim 1, etc).

5.4 Claim 1

- a) It is not apparent what is to be understood by the terms "pole plates" and "pole pieces". From page 11, lines 21-25 of the description it would appear that reference numeral (2) and (4) in figure 2 both correspond to "pole plates" which is in contradiction to the wording of claim 1.
- b) The broad scope of the wording "a gradient coils" would not appear to be supported by the description. The description merely supports that the apparatus comprises a set of **biplanar** gradient coils (see e.g. figure 2).
- c) The wording "second shimming ring is employed on the **external edge** of the first shimming ring" covers arrangements wherein the second shimming ring is aligned on the external circumference of the first shimming ring. However, the description does in no way support other arrangement than those wherein the second shimming ring is employed on that edge of the first shimming ring that faces the opposite pole (see figure 2).

The reasoned statement given above has been based on this clarification as well.

- d) It should have been clarified that "the distance with respect to the shimming ring" represents the **distance between the first shimming ring and the second shimming ring of the same pole**.
- e) The broad scope of the wording "the distance with respect to the shimming ring is adjustable" is in no way supported by the description. The description solely supports that the distance **in parallel to the axis that crosses the center of both magnet poles** of the apparatus is adjustable (see figure 2).
- f) Due to the wording "this invention has the following feature" it remains unclear whether the features defined in lines 1-22 of claim 1 form part of the claimed subject-matter or not.
- g) Page 4, lines 20-22 of the description states that "the present invention use[s] ... two or three methods **jointly** to achieve better shimming effects",

wherein the three methods are cited on page 3, line 2 - page 4, line 18 of the description. However, since claim 1 solely defines an adjustable second shimming ring which corresponds to one of the three methods only, claim 1 is in no way supported by the description.

Moreover, this discrepancy between the description and the set of claims results in doubts on the scope of the claims.

- h) The scope of the wording "**essentially** symmetrical" is unclear. Therefore, the word "essentially" should have been deleted.
- i) It is not apparent what is to be understood by the wording "the measured body". Therefore, this wording should have been defined.

It should be apparent that most of the objections equally apply to claims 9, 10 and 12.

5.5 Claim 2

The scope of the wording "**essentially** not projecting higher than" is unclear. Therefore, the word "essentially" should have been deleted.

5.6 Claim 3

- a) The scope of the wording "**essentially** distributed symmetrically" is unclear. Therefore, the word "essentially" should have been deleted.
- b) The wording "**center** point of the pole **center**" is obscure.
- c) It would appear that not **any** arrangement of magnetic columns of different magnetic energy levels would provide the desired technical effect of an increased field homogeneity. For instance, the reduction of flux leakage at the transverse borders of the magnet poles requires that the magnetic energy level of an area close to the center of the respective pole piece is smaller than that of areas which are more distant from said center. Therefore, it would appear that the full scope of claim 3 is not supported by the description and it might be appropriate to include the features of claim 6

in present claim 3. The same objection applies to claim 9 as well.

5.7 Claim 4

- a) It is not apparent what is to be understood by the term "the pole plate plane". Therefore, this term should have been defined.
- b) It would appear that the wording "an axis which ... is **vertical** to the pole plate plane" does not define more than that the axis crosses the "pole plate plane" at an arbitrary angle. Probably the axis should have been characterised as being **perpendicular** to the pole plate plane.

5.8 Claims 5, 6

It should have been clarified that the specified number of rings refers to each of the poles of the magnet.

5.9 Claim 7

It is not apparent what is to be understood by the term "the end face axis". Therefore, this term should have been defined.

5.10 Claim 9

- a) It is unclear to which direction the wording "the direction of the measured body" refers.
- b) The term "the second shimming ring" in line 17 lacks an antecedent definition.
- c) Claim 9 would not appear to contain all features that are essential to achieve the desired technical effect. From the description, it appears to be essential that an adjustable, second shimming ring is employed on the external edge of the first shimming ring.
- d) The wording "magnetic inducing bolts" is not supported by the description since the description refers to "magnetic **conducting** bolts" rather than "magnetic inducing bolts" (see e.g. page 4, line 6). Therefore, it would

appear appropriate to replace the wording "magnetic inducing bolts" by the wording "magnetic conducting bolts". The same objection applies to claims 7 as well.

5.11 Claim 10

Claim 10 is in no way supported by the description and does not contain all features that are essential to achieve the desired technical effect. From the description, it appears to be essential that the distance between the second shimming ring and the first shimming ring is adjusted such that the uniformity of the magnetic field is improved (see page 3, lines 22-30 of the description).

5.12 Claim 11

- a) Method claim 11 is obscure since, according to its preamble, this claim is dependent on claim 9 which represents an apparatus claim. It would appear that claim should be dependent on claim 10.
- b) The scope of the wording "**essentially** symmetrical" is unclear and should have been deleted.
- c) It is not apparent what is to be understood by the term "**end face axis** of the permanent magnetic source". Therefore, this term should have been defined.
- d) It is unclear whether the "magnetic **conducting** bolts" are equal to the "magnetic **conducting** bolts" referred to in the description. The same objection applies to claim 12 as well.

5.13 Claim 12

Claim 12 is in no way supported by the description and does not appear to contain all features that are essential to achieve the desired technical effect. From the description, it appears to be essential that the distance between the second shimming ring and the first shimming ring is adjusted such that the uniformity of the magnetic field is improved (see page 3, lines 22-30 of the description).